

CLAIMS:

1. A method of calculating traffic values in a communications network, the communications network comprising a plurality of nodes, the nodes being
5 connected to one another by links, the method comprising:
 - (a) obtaining traffic data measurements through said nodes and/or links in an initial scenario as input data;
 - (b) deriving a traffic flow model for a modified scenario using a plurality of constraints describing the interdependency of said initial to said
10 modified scenario; and
 - (c) calculating values and/or upper and lower bounds of traffic values for said modified scenario from said traffic flow model using said input data.
- 15 2. A method according to claim 1, wherein said modified scenario comprises one or more of: a modified network topology, modified routing algorithm parameters, modified traffic engineering constraints and/or modified traffic load compared to the initial scenario.
- 20 3. A method according to claim 1 or 2, wherein said constraints are derived from the network topology and network behaviour of the initial network.

4. A method according to claim 1, 2 or 3, wherein step (b) further comprises performing a routing procedure in said modified scenario.
5. A method according to any preceding claim, further comprising the
5 step of verifying the consistency of the measured input data using information about the network topology and/or the network behaviour of the initial scenario.
6. A method according to any preceding claim, wherein said input data
10 are corrected if inconsistencies are detected.
7. The method of claim 6, further comprising solving a linear programming problem with a linear objective function to minimise the data traffic reconciliation (error correction).
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8. The method of claim 6, further comprising solving a linear programming problem with a non-linear objective function to minimise the data traffic reconciliation (error correction).
- 20 9. A method according to any preceding claim, wherein in step (b) the traffic values in the modified scenario are expressed as a linear function of node-to-node flows in the initial scenario.

10. A method according to any preceding claim, wherein traffic values which are not affected by the modification from said initial to said modified scenario are equal to the corresponding input data or corrected input data of the initial scenario.

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11. A method according to any preceding claim, wherein said traffic values comprise utilisation, overload and/or traffic volume values.

12. A method according to any preceding claim, wherein said constraints
10 comprise linear constraints.

13. A method according to any preceding claim, wherein said constraints comprise non-linear constraints.

15 14. A method according to claim 13, wherein a linear approximation to a non-linear constraint is used.

15. A method according to any preceding claim, further comprising:
selecting a first and a second node;
20 solving a first linear programming problem by computing the upper bound of traffic flow values from the first to the second node; and
solving a second linear programming problem by computing the lower bound of traffic flow values from the first to the second set of nodes.

16. The method of any preceding claim, further comprising repeating step (a) at different times and/or at periodic intervals.
- 5 17. A method of calculating traffic values in a communications network, the communications network comprising a plurality of nodes, the nodes being connected to one another by links, the method comprising:
- (a) obtaining data traffic data measurements through said nodes and/or links in an initial scenario as input data;
 - 10 (b) considering a modified scenario;
 - (c) defining one or more solution variables for said modified scenario;
 - (d) determining constraints between traffic flows through said links and nodes to describe the network topology and
15 behaviour of the network;
 - (e) deriving a traffic flow model using said input data and said relations for calculating said solution variables.
18. A method according to claim 17, wherein step (b) further comprises
20 performing a routing process for said modified scenario.

19. A method according to claim 17 or 18, wherein said solution variables can be expressed as a linear function of one or more node-to-node flows of said network.
- 5 20. The method of claim 17, 18 or 19, wherein said constraints in step (b) include relations among data traffic rates based on the definition of network protocol (such as IP, TCP, UDP) which defines the network behaviour.
21. A method according to any of claims 17 to 20, wherein said
10 constraints comprising any of the following constraints:
- routing-based constraints
 - link-based constraints
 - node-based constraints
 - error-based constraints.
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22. The method of any of claims 17 to 21, wherein said constraints relate to any of the following:
- the size of data packets used in the network;
 - relationship between the number of data packets and the data traffic
20 volume;
 - constraints determined by the routing protocol used in the network;
 - the relationship between incoming and outgoing data traffic at said plurality of nodes;

- the relationship between the data traffic at both ends of each link;
- the relationship between the data traffic along said routes and the data traffic input into and output from the network.

5 23. A method according to any of claims 17 to 22, further comprising repeating stages (b), (c) and (d) for different modifications of said network.

24. A method according to claim 23, further comprising calculating a minimal and a maximal value for each solution variable taking into account
10 one or more of said different modifications.

25. A method according to claim 23 or 24, further comprising calculating one consistent solution for all solution variables taking into account all said modifications.

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26. An apparatus for calculating traffic values in a communications network, adapted to perform the method of any preceding claim.

27. A network management system for managing a network comprising a
20 plurality of nodes, the nodes being interconnected by links, the network management system comprising:

means for measuring the data traffic input into and output from nodes and links and

the apparatus of claim 26.

28. A computer program for performing the method of any of claims 1 to 25 when operated in a computer system.

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29. A method of calculating data traffic substantially as described herein with reference to the accompanying drawings.